Resurrection of *Sepedon pacifica* Cresson and Redescription of *Sepedon praemiosa* Giglio-Tos with Biological Notes

(Diptera: Sciomyzidae)

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Giglio-Tos (1893) based the original description of *Sepedon praemiosa* on a single male from Morelia, Mexico, and later (1896) elaborated on the description of the type. Neither verbal treatment is adequate to distinguish *S. praemiosa* from similar species. The type specimen is believed to be in the museum of the University, Turin, Italy. However, unanswered correspondence makes confirmation impossible.

Cresson (1914) described *S. pacifica* from a male collected in Marin Co., coastal central California. We have examined this specimen. Its color is somewhat faded, but the terminalia agrees with our concept of this taxon. Interestingly, Melander (1920) accepted Cresson's designation of *S. pacifica*. Apparently both workers were aware of *S. praemiosa* only from the catalogue by Aldrich (1905), and assumed from the type locality that it was a different species. It is doubtful that either worker had seen the Giglio-Tos type, and they, therefore, considered *S. pacifica* a distinct species. It is fortuitous that all of the localities listed by Cresson and Melander fell within the area of distribution we now ascribe only to *S. pacifica*.

Steyskal (1950) placed *Sepedon relictus* van der Wulp (v. d. Wulp, 1897) and *S. pacifica* Cresson (Cresson, 1914) in synonymy with *S. praemiosa*. Through the courtesy of K. G. V. Smith, British Museum of Natural History, we have examined the van der Wulp type specimen which is a female (not a male as recorded in Biologia Centrali-Americana) and have compared it with a number of females of *S. praemiosa* taken at various localities from Oaxaca, Mexico, to Colorado, U. S. A. and cannot assign it to *S. praemiosa*. We recommend that *S. relictus* van der Wulp be removed from synonymy. The *S. relictus* type fits very well the description of *S. haplobasis* Steyskal (Steyskal, 1960), and we suspect that it is conspecific with that species. However, at this writing (6 October 1971, revision of the original manuscript) specimens of *S. haplobasis* are not at hand for comparison.

Although neither Steyskal nor we have seen the *S. praemiosa* type

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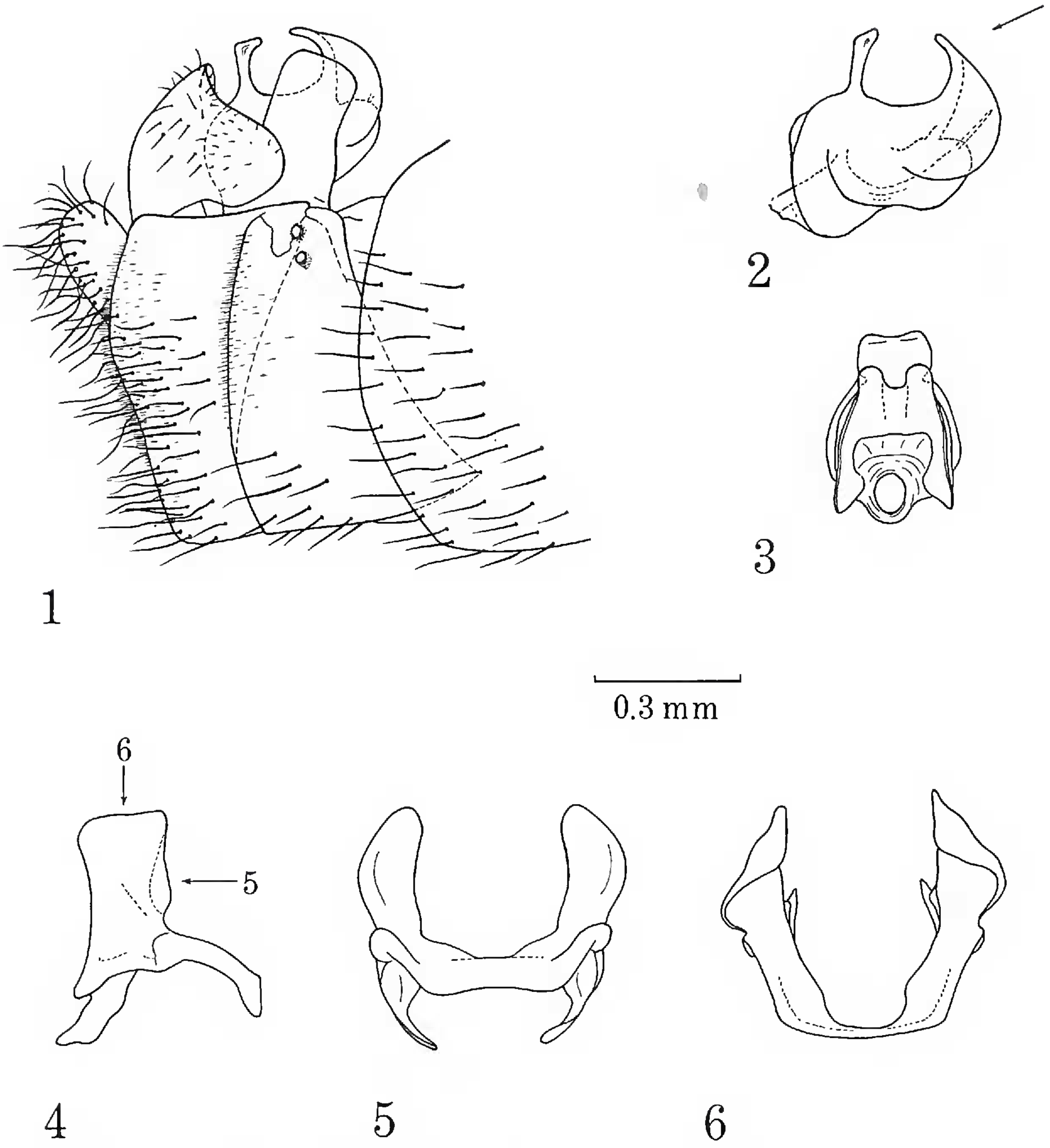
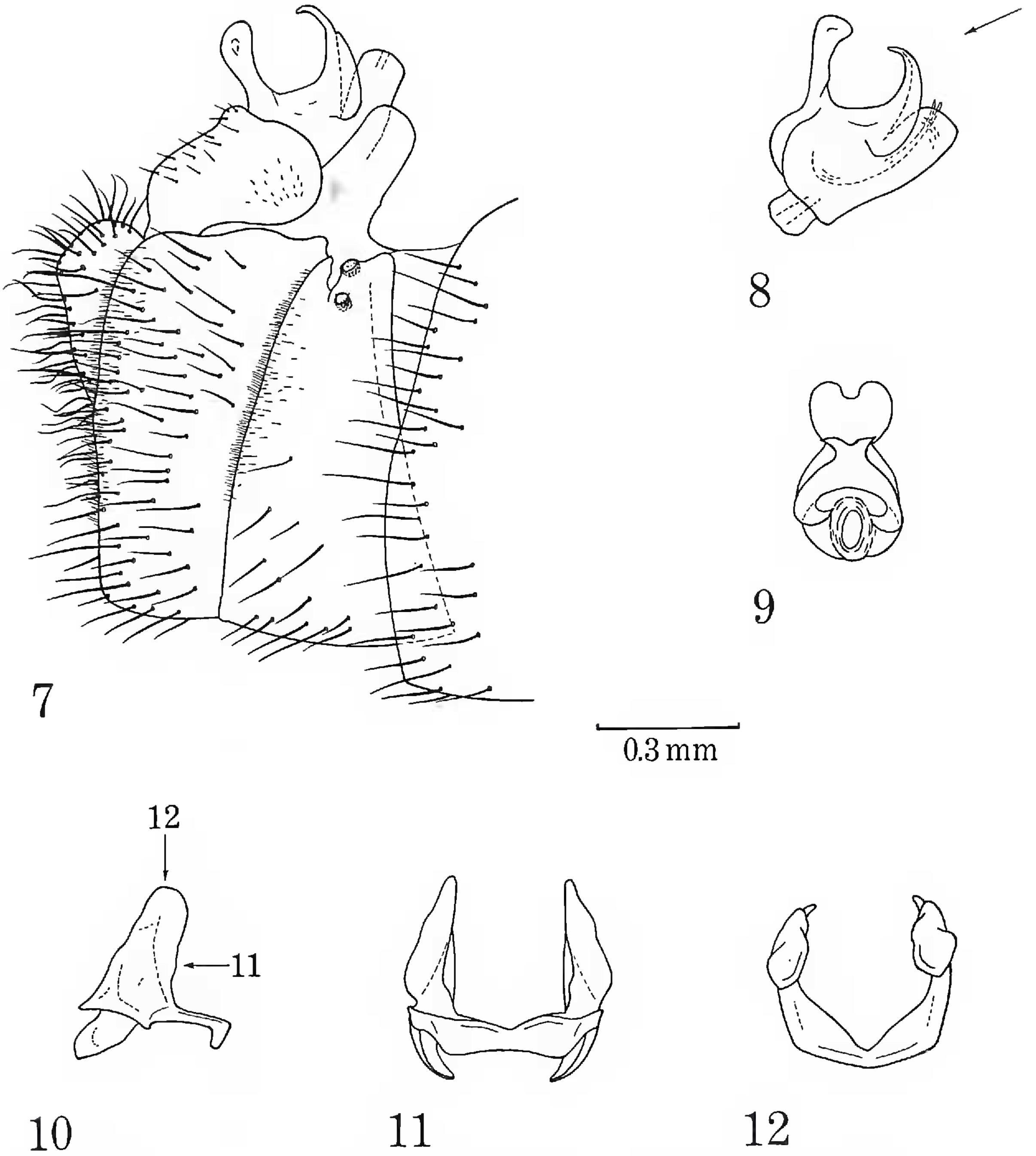


FIGS. 1–6. *Sepedon praemiosa* Giglio-Tos, U.S.A., Colorado, Fremont Co., 20 Aug. 1959 (N. Marston). Wing length of this specimen, 7.0 mm. FIG. 1. Terminalia, sinistral view, inverted. FIG. 2. Aedeagus, sinistral view. FIG. 3. Aedeagus, oblique anterior view from direction of arrow in Fig. 2. FIG. 4. Hypandrium, sinistral view, inverted. FIGS. 5–6. Hypandrium viewed from directions of arrows in Fig. 4.

specimen, examination of a rather large amount of material from western North America, including specimens from Morelia, which we designate as topotypes of *S. praemiosa*, persuade us that the appelation is correct.

We became aware of two forms of *S. praemiosa* in 1966, and since have had at hand over 4,000 specimens which we assign to the taxon *S. pacifica* and 267 specimens to *S. praemiosa*. Both are clearly separated by differences in distribution and in the morphology of primary



Figs. 7–12. *Sepedon pacifica* Cresson, U.S.A., Colorado, Ft. Collins, 16 April 1958 (N. Marston). Wing length of this specimen 8.3 mm. Fig. 7. Terminalia, sinistral view, inverted. Fig. 8. Aedeagus, sinistral view. Fig. 9. Aedeagus, oblique anterior view from direction of arrow in Fig. 8. Fig. 10. Hypandrium, sinistral view, inverted. Figs. 11 and 12. Hypandrium viewed from directions of arrows in Fig. 10.

and secondary sexual structures of the males. Although the specimen drawn by Steyskal (1950, fig. 13) and labelled *S. praemiosa* cannot now be located, that illustration agrees well with our concept of *S. pacifica*.

Other than the material collected by us during the survey phase of California Experiment Station Project No. 2037, "Biological Control of Non-marine Mollusks," material was kindly provided by C. O. Berg

(Cornell University), N. Marston (Kansas State University), L. V. Knutson and G. C. Steyskal (Systematic Entomology Laboratory, USDA), P. H. Arnaud (California Academy of Sciences), W. F. Barr (University of Idaho), and entomological collections of Illinois Natural History Survey, Oregon State Department of Agriculture, South Dakota State University, Texas A. & M., University of Minnesota, University of Wisconsin, and the University of California at Berkeley, Davis, and Riverside. Material from S. S. Roback (Academy of Natural Sciences, Philadelphia) included the type of *S. pacifica* Cresson.

Comparison of *S. pacifica* and *S. praemiosa* reveals consistent differences in primary and secondary genitalic structures in the males (Figs. 1–12). With the genitalia extruded—as with fresh material, or with dried material after light boiling in 10% KOH—the lateral and oblique anterior aspects of the aedeagus are diagnostic (Figs. 2, 3, 8, 9).

In general *S. pacifica* appears to be a larger and darker species than *S. praemiosa.* The relative sizes of the sexes are also different. In *S. praemiosa* the males are smaller than the females, but the reverse occurs in *S. pacifica.* However, in proportion to their size, the male genitalic structures of *S. praemiosa* are larger than those of *S. pacifica.* This size relationship is illustrated by comparing the terminalia and especially the hypandria of the two species (Figs. 4, 5, 6, 10, 11, 12—all drawn to the same scale).

NEALLOTYPE, S. PACIFICA.—female, ½ mi. w. Valley Ford, Sonoma County, California, 100 ft., 13 June 1966, AS-485 (T. W. Fisher & R. E. Orth), plus 20 California specimens were deposited in the Academy of Natural Sciences, Philadelphia. In addition 20 California specimens were deposited at the United States National Museum.

TOPOTYPES, S. PRAEMIOSA.—1 ♀, 2 ♂, 8 mi. e. Morelia, Michoacan, Mexico, 1 May 1953 (R. C. Bechtel & E. I. Schlinger). Specimens were collected in sweep nets while sampling the edge of a bean and squash field which was adjoined by a swampy river and marsh. 1 ♀, 1 ♂ plus 10 additional specimens deposited in United States National Museum. 1 ♂ topotype plus 10 specimens to the University of California at Berkeley.

VARIATION.—Unlike most specimens seen, certain specimens from several localized populations of *S. pacifica* in northern California, Oregon, Washington, and Idaho possess prominent black parafrontal spots. [We have also seen this variation in occasional specimens of *S. fuscipennis* from Oregon, Washington, Idaho, and New Mexico.]

The ability to separate *S. praemiosa* from *S. pacifica* on genitalic characteristics has made it possible to reevaluate certain superficial characters to the degree that such characters now assume a diagnostic role of some importance. One such character pertains to the facies. In *S. praemiosa* the color of the facies is much lighter, almost yellowish, when compared to the darker, brownish face of *S. pacifica.* All the *S. pacifica* we have seen have from few to many fine hairs on the medifacies, but approximately 25% of the specimens of *S. praemiosa* we have seen from several localities have no hairs on the medifacies.

Localities where barefaced *S. praemiosa* were collected include: *Mexico.*—Durango (Durango); Michoacan (Morelia). *U.S.A.*—Arizona (Lake Mary nr. Flagstaff); Colorado (Las Animas and Walsenburg); Nebraska (North Platte); New Mexico (Las Cruces, Bob Crosby Draw).

Because of the occurrence of a rather large percentage of barefaced *S. praemiosa,* it now seems advisable to utilize a key character other than "medifacies with fine black (scattered) hairs" to lead to this species, or if key characters currently in use are perpetuated, mention should be made of the rather common occurrence of glabrous medifacies in *S. praemiosa* in the same couplet wherein hairy medifacies are referred to. In similar context, parafrontal spots become of questionable value as primary criteria to separate species of *Sepedon.*

The following key is adapted from Steyskal 1950, with particular emphasis on robust species. The wing length is measured from the basal fracture line. The stated measurements represent the extremes as based on the specimens at hand. The means fall well within the extremes which constitute a very small percentage of total numbers examined. In most species females are larger than males. *S. pacifica* occasionally overlaps the size range of *S. praemiosa,* but since the two do not overlap in distribution to our knowledge, size alone will not be a critical determinative factor. Determination of material from areas of known or potential overlap should be based primarily on proper examination of male genitalia.

In the area covered by our key taxa currently included in the *armipes* group are *S. anchista* Steyskal, *S. armipes* Loew, *S. bifida* Steyskal, *S. capellei* Fisher and Orth, *S. haplobasis* Steyskal, *S. melanderi* Steyskal, and *S. pseudarmipes* Fisher and Orth. *Sepedon haplobasis* Steyskal is reported only from Mexico, D. F.; male hind femur notched, wing length 4.6 to 5.5 mm, females 5.1 to 5.9 mm. The *pusilla* group consists of *S. borealis* Steyskal, *S. lignator* Steyskal, *S. neili* Steyskal, and *S. pusilla* Loew. *Sepedon guatemalana* Steyskal was reported by Neff and Berg (1966, p. 41) from Las Cruces, Chiapas, Mexico, approximately 17° latitude, and thus is the most northern taxon known of the *lindneri* group. A presumed range extension of *S. macropus* Walker is provided by a single female collected by the senior author on the west coast of Mexico, Sonora, 0.5 mi. s. of sign to Potam, 300 feet, 5 October 1967.

Publications which contain illustrations of adult *Sepedon* are those by Steyskal (1950, 1956, 1960), Foote (1961), Yano (1968), and Fisher and Orth (1969). Biologies and distribution maps for 14 taxa of North and Central America are reported by Neff and Berg (1966).

Key to the Nearctic and Mexican Species of Sepedon Latreille

1 Supraspiracular convexity of metathorax with black hairs 2
Supraspiracular convexity of metathorax without black hairs 10

2 Robust species; wing length 5.8 to 8.9 mm; hind femur of males without midventral notch 3
Smaller species; wing length 3.6 to 5.5 mm; hind femur of males with or without midventral notch. North of Tropic of Cancer 8

3 Medifacies with or without fine black hairs; femora orange-yellow to reddish brown with or without bicoloration of black 4
Medifacies, females, without fine black hairs; femora yellowish, not bicolored; wing length 5.5 to 6.4 mm, (smaller females and all males covered by 2′). U.S.A. north of 38° latitude and Canada. [Steyskal, 1950] .... *S. spinipes americana* Steyskal

4 Hind femur slender, much longer than abdomen, length = 69–78% wing length, black apically with or without distinct black annulus. Subtropical to tropical 5
Hind femur thickened, not or but little longer than abdomen, length = 56–59% wing length. Subtropical to temperate 7

5 Middle femur with strong midanterior spinule 6
Middle femur without strong midanterior spinule. Trinidad. [Steyskal, 1950] .... *S. trinidadensis* Steyskal

6 Hind femur with blackish pre-apical annulus. Tropical lowlands of eastern Mexico north to extreme southern Texas, Central America, Columbia. [Walker, 1849, p. 1078] .... *S. macropus* Walker
Hind femur black on apical third. Puerto Rico, Dominica, Haiti. [Melander, 1920] .... *S. caerulea* Melander

7 Face yellowish to amber, with or without scattered fine black hairs on medifacies—may be totally bare; wing length males 5.8–7.2 mm, females 6.3–7.3 mm; hind femur usually less than 4 mm; genitalia as Figs. 1–6. Southwestern Nebraska, western Kansas, Colorado, Arizona, New Mexico, Mexico highlands to Oaxaca; 1,100–8,000 feet. [Giglio-Tos, 1893, 1896] .... *S. praemiosa* Giglio-Tos
Face amber to brownish, medifacies with fine black hairs scattered to moderately dense; wing length males 7.2–8.9 mm, females 7.0–8.0 mm; hind femur usually greater than 4 mm; genitalia as Figs. 7–12. All states west of Rocky Mts. (no records from Arizona); east of Rocky Mts.

north of 40° latitude and east to 96° 28′ longitude; extreme southern portions (50° latitude) of western Canadian Provinces; sea level to 10,150 feet. [Cresson, 1914] .... *S. pacifica* Cresson

8 Male hind femur emarginate ventrally; female hind femur simple; hind tibia distinctly more curved in distal third; abdomen brown with little more than a trace of bluish reflection; oral margin usually raised, rectangular in profile; tp almost straight. Canada, U.S.A., Mexico. [Steyskal, 1950, 1956, 1960; Fisher and Orth, 1969] .... *S. armipes* group

Hind femur of both sexes simple 9

9 Hind tibia more or less evenly arcuate; abdomen frequently almost black with bluish reflections; oral margin usually low, the angle with face acute; wing length males 3.6–4.5 mm, females 3.9–4.9 mm; femora orange-yellow to dark brown; medifacies with fine black hairs. North of 37° latitude. [Steyskal, 1950] .... *S. pusilla* group

Wing length males 5.0 to 5.5 mm, females 5.5 to 6.4 mm; femora yellowish; medifacies without fine black hairs. U.S.A. north of 38° latitude, Canada. [Steyskal, 1950] .... *S. spinipes americana* Steyskal

10 Robust species; wing length 6.3 to 7.6 mm. U.S.A., Canada 11

Smaller species. South America, Central America, Mexico (Chiapas, 2,200 feet). [Steyskal, 1950] .... *S. lindneri* group

11 Second antennal segment compressed, about three times as long as wide (viewed laterally), near base much wider than first segment. Widespread in U.S.A. and Canada, rare in California (Plumas, Sierra counties) and New Mexico (Rio Arriba, Sandoval counties), no Arizona or Nevada records. [Loew, 1859; subspecies Steyskal, 1950] .... *S. fuscipennis* Loew

Second antennal segment almost cylindrical, nearly five times as long as wide, basally not thicker than first segment; oral margin in profile acute. U.S.A. and Canada east of 101° longitude. [Cresson, 1920] .... *S. tenuicornis* Cresson

BIOLOGY, LABORATORY.—In late July 1970 we collected 50 *S. praemiosa* at Lake Mary, near Flagstaff, Arizona, and brought them to Riverside for propagation in the laboratory. Upon our return to Riverside we collected *S. pacifica* locally. The object of these collections was to initiate reciprocal cross mating studies. Many F_1 progeny of *S. praemiosa* were produced, and on 24 August 1970, 60 F_1 puparia were sent to Honolulu, Hawaii, c/o C. J. Davis, Chief Entomologist, for propagation and release against *Lymnaea ollula* Gould. There were enough F_1 adults of *S. pacifica* produced to enable us to set up reciprocal crosses of groups of four females and four males as well as control groups of both species. The results indicated interspecific mating incompatibility, but were inconclusive. The F_1 controls of *S. praemiosa* mated and produced viable eggs but all the larvae died before or during the third instar. The F_1 controls of *S. pacifica* mated but no eggs were laid. In the reciprocally cross mated groups no mating of F_1 adults was observed and no eggs were laid.

Although the reasons for failure of these attempted crosses are obscure, certain comments are considered appropriate. The F_1 larvae were reared on a diet of virtually 100% *Physa virgata* Gould, and a high percentage of both species attained the third instar and then died. Many successfuly pupated, but emerged deformed and soon died. Curiously, our insect pathologist colleagues at Riverside could identify no pathogens in moribund or recently dead material. Possibly, the diet solely of *P. virgata* did not provide all the nutrients required for normal development. Another factor we have recognized in these and other species of sciomyzid flies—as also reported by Neff and Berg (1966)—is that late season (September, October) attempts at laboratory propagation often fail, even with fresh appearing adults. Perhaps a form of ovarian diapause is responsible—a possible survival factor in species suspected of overwintering as adults, and whose immatures could not survive.

We concur with the generalized observations reported by Neff and Berg (1966) for their laboratory rearings, i.e., 3 to 5 days egg incubation period, 12 to 20 days in the three larval stadia, and 5 to 9 days in the pupal stage. In their paper, the biology of *S. praemiosa*, including descriptions of the immature stages, was presented in considerable detail. However, we call attention to the facts that their cultures consisted of material from three localities—(1) Oxaca, Mexico, collected August 1958; (2) Cypress Lake, Saskatchewan, Canada, collected July 1957; and (3) Riverside, California, collected January–February 1961. [Larvae from the Riverside material were taken to Hawaii and Australia by Berg the following August for testing against the freshwater snails *Lymnaea ollula* Gould and *L. tomentosa* Pfeiffer, respectively. Ref. Neff and Berg (1966, p. 48)]. Although no biological or morphological differences between immatures from the three localities were reported, we consider the first to be *S. praemiosa*, and the second and third to be *S. pacifica*.

BIOLOGY, FIELD.—The general statement by Neff and Berg (1966, p. 48) that "the species (*praemiosa*, = *pacifica*) breeds throughout the year in southern California . . ." may hold for coastal or low elevations, but it does not pertain to the higher elevations, such as Big Bear Lake at 6,750 feet in the San Bernardino Mts. or to Lake Hemet, at 4,500 feet in the San Jacinto Mts. We have sampled both localities extensively over a period of years. Our contention is particularly true at Big Bear Lake which sometimes is frozen over, and nearly every year has substantial snow cover during December, January, and February. Water temperatures during these months are in the low 40's °F or upper 30's °F. At comparable and higher elevations in the northern parts of the state where *S. pacifica* occurs winter conditions are more severe. Because of these observations we are reluctant to comment on the exact mode of overwintering in cold areas.

It seems reasonable that the onset of winter would find eggs, larval stadia, and pupae present as well as adults. To begin elucidation of the mechanisms involved, temperature tolerances of all stages require critical study as do other ecological parameters such as day length, light intensity, etc., and the interactions of such stimuli. Perhaps all stages are merely arrested developmentally, perhaps developing a little on warmer winter days. What the larvae would feed on is another question, since at many sites migrating water fowl consume most of the exposed mollusks during the fall and early winter. Surviving aquatic mollusks are buried in the mud, or are on rocks below the mud line, or in lakes they may be in vegetation well below the surface. In such situations they are beyond the reach of bird or fly-maggot predators.

DISTRIBUTION AND RELATIVE ABUNDANCE OF S. PRAEMIOSA, S. PACIFICA, AND S. FUSCIPENNIS.—These three large and superficially similar species are usually encountered in open, unshaded marshes. Most such habitats contain aquatic pulmonate snails of the families Planorbidae, Lymnaeidae, and/or Physidae. In the laboratory the larvae of the three species of marsh flies consume a wide variety of aquatic snail species (Neff and Berg, 1966). Although precise host associations in nature or nutritional requirements remain to be elucidated, the assumption presently is that since the larvae of these species feed as overt predators, their nutritional requirements are not tied to any particular species of mollusk.

We know of no locality (microhabitat) where *S. pacifica* and *S. praemiosa* occur together. A waterway common to both appears to be the South Platte River. *Sepedon pacifica* occurs along its western reaches in northeastern Colorado, and *S. praemiosa* occurs at North Platte in southwestern Nebraska. The intermittent nature of the river during the summer may serve to keep the species separated, but it is possible that seasonally the two species may coexist along this watercourse as well as the North Platte River possibly in the vicinity of the western boundary of Nebraska.

Sepedon fuscipennis is widespread in the U.S.A. and Canada. It is found in association with *S. pacifica* in several localities west of 100° longitude. In the Pacific states the two species occur together in California (south of Crescent Mills, Plumas Co.; west of Sierraville, Sierra

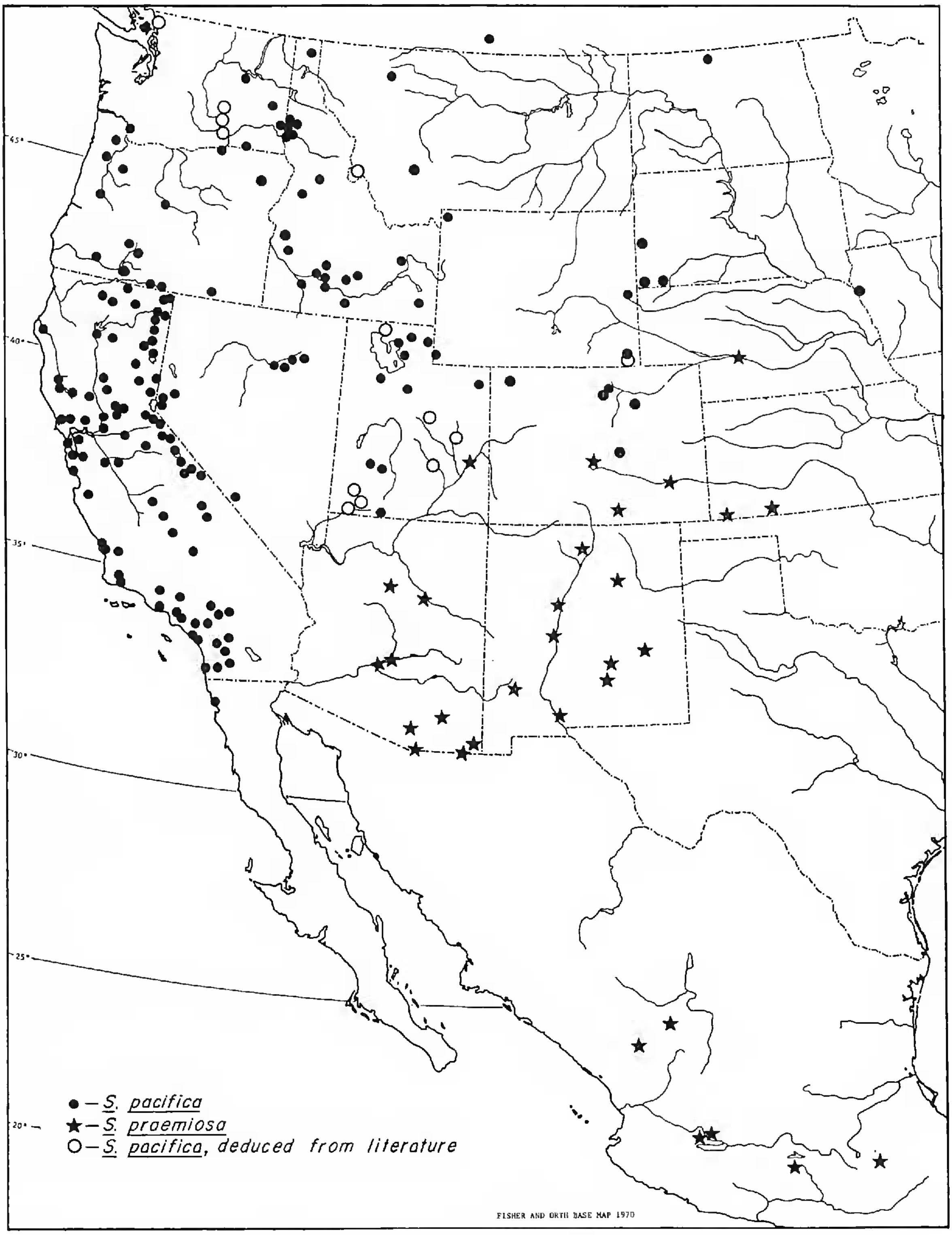

45°
40°
35°
30°
25°
20°
● — S. pacifica
★ — S. praemiosa
○ — S. pacifica, deduced from literature
FISHER AND ORTH BASE MAP 1970

FIG. 13. Distribution of *S. pacifica* and *S. praemiosa*. We have seen specimens from all localities indicated by the blackened circles and stars. Clear circles indicate material not seen but referred to in the literature as *S. praemiosa* or *S. pacifica* and which because of distribution, we assign to *pacifica*.

Co.), Oregon (Eugene, Lane Co.; Klamath Game Refuge, Klamath Co.), and in Washington (south of Kalama, Cowlitz Co.). Foote (1961) reported *S. praemiosa* (= *S. pacifica*) and *S. fuscipennis* from Idaho (Coeur d'Alene and Robinson Lake) and Alberta, Canada (Lethbridge).

The only sites where we are certain *S. praemiosa* and *S. fuscipennis* occur together is a roadside marsh just east of North Platte, Nebraska, and in the Jemez Mts., Sandoval Co., New Mexico. In spite of rather intensive collecting efforts by us and others in the western states and Canada it is curious that *S. fuscipennis* has been reported together with *S. pacifica* or *S. praemiosa* at relatively few sites.

Localities where the three species have been reported singly but where overlap may be anticipated are as follows. We have taken only *S. fuscipennis* at Amargosa and Pike's Stockade in southern Colorado; at Chehalis, Centralia, and Silver Lake in Washington; and at Cave Junction, in Oregon. Foote (1961) reported only *S. fuscipennis* from six localities in Idaho, one in Montana, four in Washington, two in Oregon, two in Alberta, and three in British Columbia. We have taken only *S. praemiosa* at Walsenburg, Colorado, and at Lake Mary (8 miles southeast of Flagstaff), Arizona. Only *S. pacifica* (= *S. praemiosa*, Foote, 1961) was reported by Foote (1961) from 14 sites in Idaho, 28 in Utah, five in Washington, two in Oregon, and one in Alberta.

Material we have seen, and assumptions from literature records (Steyskal, 1950; Neff and Berg, 1966; Foote, 1961) indicate that in the U.S.A. *S. praemiosa* occurs east of the Rocky Mts. at North Platte, Nebraska, (approximately 41° latitude, 120° longitude), in eastern Colorado, southwestern Kansas, and along the Rio Grande watershed in New Mexico. West of the Rocky Mts., *S. praemiosa* occurs in Arizona near Phoenix and Flagstaff and in the southeastern portion of the state. The gorges of the Colorado River and Little Colorado River appear to be the northern limit of its distribution in Arizona, but a male was seen from Moab, Utah. South of the International Border, *S. praemiosa* occurs in the central highlands of Mexico to Oaxaca, 17° latitude. The present occurrence of isolated populations of *S. praemiosa* in well separated drainages suggests that there may have been wet periods in the geological past that would have effected a continuous suitable habitat from Oaxaca to Nebraska, or possibly farther north. Although we have seen no material from Texas or Mexico from the Rio Grande or its tributaries, this watershed probably enabled the species to penetrate as far north as it has.

Sepedon pacifica occurs west of the Rocky Mts. from northern Baja California del Norte, Mexico, 32° latitude, to 50° latitude, becoming rare in northwestern Washington and western British Columbia, Canada. East of the Rocky Mts. it occurs between 40° and 50° latitude. Its easternmost confirmed occurrence is Sioux City, Iowa, 96° 28′ longitude. We saw the material on which the Neff and Berg (1966) record from

North Dakota and records in South Dakota and northeast Colorado were based and assign it all to *S. pacifica.*

The arid southwestern U.S.—Sonoran Desert creates the zoogeographic barrier which effectively separates *S. pacifica* from *S. praemiosa.* A curious fact is that we have never collected either species, nor do we know of any confirmed records, along the Colorado River which bisects this desert, nor in the high or low deserts of southeastern California and the contiguous areas of Nevada and Arizona.

The paucity of *S. praemiosa* and *S. pacifica* in the Colorado River drainage system may be caused by the intermittent turbulence and velocity with the heavy load of silt carried by that river which is a deterrent to snail development. The dams which have been constructed over the past forty years are holding much of the silt that otherwise would flow the length of the river. The result is that relatively calm and clear water habitats are becoming more common. Perhaps in time this alteration of the habitat will be taken advantage of by species of pulmonate gastropods which are suitable, if not necessary, host of *S. pacifica* and *S. praemiosa,* namely planorbid snails, and these sciomyzid flies will thus be able to extend their range.

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